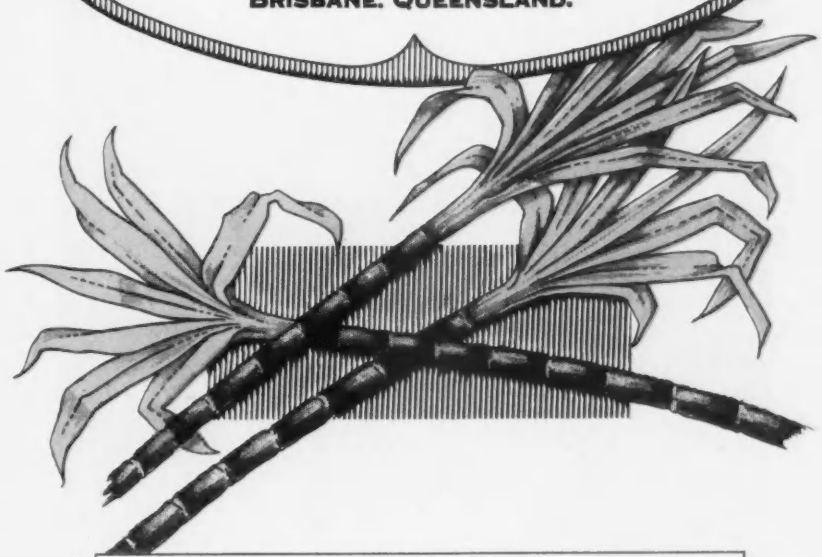
DEPARTMENT OF AGRICULTURE AND STOCK.

The CANE GROWERS' QUARTERLY BULLETIN

ISSUED BY
BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE, QUEENSLAND.



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FROST DAMAGE IN CANE.
ENTOMOLOGY IN HAWAII.

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BUREAU OF SUGAR EXPERIMENT STATIONS
BRISBANE

THE
CANE GROWERS'
QUARTERLY BULLETIN

ISSUED BY DIRECTION OF THE
HON. F. W. BULCOCK, MINISTER
FOR AGRICULTURE AND STOCK

1 OCTOBER, 1935

DAVID WHYTE, GOVERNMENT PRINTER, BRISBANE

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The
Cane Growers' Quarterly
—Bulletin—

VOL. III 1 OCTOBER, 1935 No. 2

New Form of Rat Bait.

ONE of the most interesting papers presented to agriculturalists at the recent International Technologists' Conference in Brisbane, dealt with the rat pest in cane areas, and was prepared by Mr. K. Gard, of Macknade. It sets out the results of extensive researches on the habits of the various species of rat which damage cane in Queensland, and concludes with a discussion of control measures which have been tried out in the Ingham district.

Of particular interest to canegrowers is the description of a new form of bait preparation which was devised by Mr. M. S. Barnett, of the Colonial Sugar Refining Company. This bait seems to combine all the desirable features of a highly satisfactory rat poison, and would appear to possess advantages over all other preparations which have been employed to date. The essential features are a paper container, rolled in the form of a cigarette, which is saturated with raw linseed oil, plugged at both ends with hard paraffin wax, and containing sufficient poisoned wheat to kill a fully grown rat.

It has been shown that linseed oil is an excellent attractant for the rat, while the poison cylinders (or "poisils") as prepared are rendered perfectly waterproof by the oil and wax treatment. The poisils are marketed in the form of a compact "wheel" which contains 600 or more baits; the wheel is held together by the paraffin coating top and bottom, but can readily be broken up by hand and the individual baits removed as required.

The paper concludes by stating that "this form of bait, prepared preferably with thallium sulphate, recommends itself as the most suitable one devised up to the present, being safe, handy, cheap, durable and effective." It was the opinion of the overseas entomologists attending the Conference that this method of bait preparation appeared destined to change the entire aspect of rat control, and marked one of the most important advances in this field in recent times.

H.W.K.

A Fertilizer Gun.

By N. J. King.

THE device illustrated in the attached sketch could be used with advantage by most cane growers. The problem of top dressing a field with sulphate of ammonia cheaply and expeditiously often arises, and in the past several methods have been adopted. Most brands of sulphate of ammonia are lumpy, and unsuitable for the vibrator; but even with the English "sugar crystal" type of sulphate (which runs easily through the machine) there are times when the vibrator cannot be used. The cane may be too far advanced for a horse to be used—as in the case of a standover crop—or the ground may be too wet after rains for horse work; and it is at such a time that the grower desires to do his top dressing. Frequently, boxes or tins are utilised for hand top-dressing, and old sacks slung over the shoulder by means of a strap and with a hole in the corner are widely employed, the sulphate of ammonia being allowed to run from the hole as the worker walks along the row. These devices all serve their purpose but are, at the most, make-shifts.

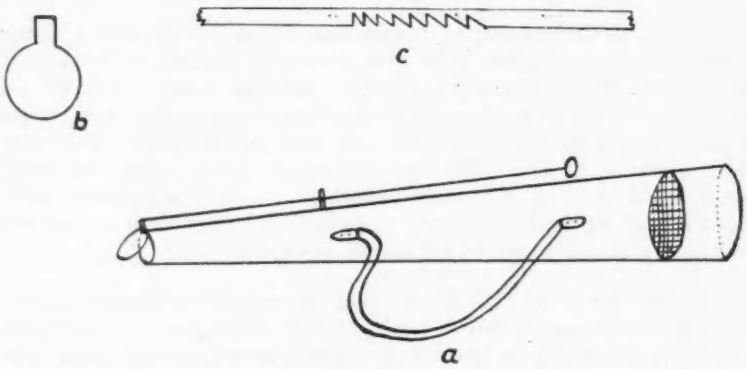


Fig. 10.—Illustrating the Method of Constructing a Simple and Effective Fertilizer Gun.

In the sketch shown (Fig. 10 *a*) the fertilizer gun is a conical-shaped container made of 24 gauge galvanised iron. At the smaller end is a "flap-valve" made of the same material and attached to the container by means of a hinge at the top. Fig. 10 *b* shows the flap valve and it is seen that the flap is extended somewhat above the hinge. To this extension is attached a rod about ¼-inch diameter and some 18-inches to 2 feet in length running through a guide which is riveted to the gun and terminating in a handle which can be made by bending the rod to the required shape. The rod is provided with slots over portion of its length as shown in Fig. 10 *c*, to allow the flap to be set in any particular

position. By pulling on the handle the flap will open any required distance and, by means of the cut-away sections, will stay in that position until altered by the operator.

Inside the top of the gun is set a screen made of half-inch mesh wire. The sulphate of ammonia is poured in through this screen and any lumps remaining on the wire can be rubbed through. No lid is necessary on the gun. A strap is riveted on as shown so that the device can be slung over the shoulder.

The writer is given to understand that a similar fertilizer gun (Fig. 11) is used widely in Hawaii and that it can be constructed to any size depending on the desire of the operator. Generally a boy carries a gun containing 40 lbs. sulphate of ammonia, and a man some 60-70 lbs.

Fig. 11.—The Fertilizer Gun Employed in Hawaii.

It can be seen that with very little practice a farmer would find at what setting the flap-valve would deliver 100, 150, or 200 lb. per acre, and could fill the gun accordingly to do so many rounds, depending on the length of the row. The device is simple and cheap to construct and could be made by any plumber.

District Cane Exhibits at Brisbane Show.

By H. W. Kerr.

THE Royal National Show which is staged in Brisbane in August each year has been aptly described as the "shop window of Queensland." There are displayed specimens of the best this State can produce in all phases of agricultural industry, and the show is a potent force in the education of the public regarding the potentialities of our State.

The sugar industry provides, perhaps, the only important exception to this statement, for it must be admitted that the exhibit of cane which is presented from year to year fails to do justice to an industry of such magnitude and importance to the State. With a view to rectifying this anomaly, an attempt was made this year to initiate an annual District Cane Competition, in which all the major sugar districts of the State would participate, thus affording them an opportunity to demonstrate their merits as cane producers. Twelve districts were embraced by the scheme—Mossman, Cairns, Innisfail, Tully, Ingham, Lower Burdekin, Proserpine, Mackay, Bundaberg, Isis, Maryborough, and Moreton. In the terms of the competition, each district was required to submit six sticks of each of three approved varieties, together with a stool of cane of any approved variety. No restriction was placed on the farm or farms from which the cane was drawn, provided it was the produce of the area. The scale of points on which the awards were made is as follows:—

Stool of cane	20 points
Sticks of three varieties	30 points
Total	50 points

It was considered that this method of judging would be equally just to all districts, and would place no particular variety in an advantageous position.

The response to the appeal was most encouraging, though it was not so wholehearted as was hoped. Seven districts were represented, and the quality of the cane submitted was of a very high order. The results were:—

1st place	Lower Burdekin
2nd place	Mossman
3rd place	Mackay

A valuable silver cup has been donated for this competition by the Royal National Association, and it is proposed that the district acquiring the greatest number of points over a period of five years shall become the outright winner of the trophy.

It is anticipated that in future years greater interest will be displayed by the respective cane districts, and that all will assist in making this exhibit the attraction which it doubtless should become. Certainly there is no monetary gain for the successful district, nor is there any expense involved in the preparation and despatch of exhibits, as this is borne by the National Association; but it does afford the sugar areas of the State an opportunity to advance the claims of their districts, and, above all, to show the people of Queensland that the industry can produce canes equal to the world's best.

Varietal Trial at Bundaberg.

In the October, 1934, number of the Quarterly Bulletin were reported the results of varietal trials conducted in the Bundaberg area to determine the relative yielding capacity of the new gum-resistant varieties in comparison with the older standard canes.

Results are now to hand for the first ratoon crop from one of these trials, and the following table summarises the yields for plant and ratoon crops:—

Messrs. Gahan Bros.' Farm, Tantitha.

Soil type:—Alluvial loam.

Variety.	Plant Crop.		First Ratoon Crop.	
	Cane per Acre.	* C.C.S. in Cane.	Cane per Acre.	† C.C.S. in Cane.
	Tons.	%	Tons.	%
Q. 813	14.2	15.4	10.1	12.2
P.O.J. 234	27.8	**15.9**	17.2	13.9
P.O.J. 2875	22.0	14.3	19.1	**14.0**
P.O.J. 2878	26.7	14.0	21.4	13.9
Co. 290	**37.1**	14.4	**45.8**	13.4

* Laboratory mill tests. † Mill tests.

The results of this trial show that Co.290 gave by far the greatest yield of cane per acre for both plant and ratoon crops; the superiority of this variety in the ratoons is most marked, as it gave a crop four and a half times as heavy as that from Q.813.

In c.c.s. values, P.O.J. 234 was best in the plant crop; P.O.J. 2875 led by a small margin in the ratoons, when all varieties excelled the standard, Q.813. Though Co.290 is not noted for its high sugar content, the above results are clearly in favour of the planting of this cane under the particular conditions of the trial.

G.A.C.

Varietal Trial at Babinda.

In 1934 a comparative yield trial between Badila and P.O.J. 2940 was harvested on the farm of Mr. T. Cowles, McDonnell Creek, Babinda. The land selected for the trial was an area where Badila does not thrive, but it was able to outyield the Javan variety in the plant crop. The P.O.J. 2940 ratooned well, however, and made better growth than Badila throughout the season. The comparative yields for both crops are as follows:—

Variety.	Plant Cane.		First Ratoons.	
	Cane per Acre.	*C.C.S. in Cane.	Cane per Acre.	*C.C.S in Cane.
	Tons.	%	Tons.	%
P.O.J. 2940	16.4	14.2	**15.8**	14.3
Badila	**20.9**	**14.8**	9.4	**17.6**

* Laboratory mill tests.

It will be observed that, for the ratoon crop, the c.c.s. of the P.O.J. 2940 is more than three units below that of the Badila, and this is a serious drawback. It has been decided to ratoon the block again, and closer attention will be paid to the period of maturity of the new variety.

G.B.

A New Trash-Cutting Device.

A novel plough attachment for cutting trash into short lengths preparatory to ploughing under is illustrated in Fig. 12. It is the invention of a Bundaberg canegrower, and should be received favourably by those farmers desirous of accomplishing this operation with ease and complete success.

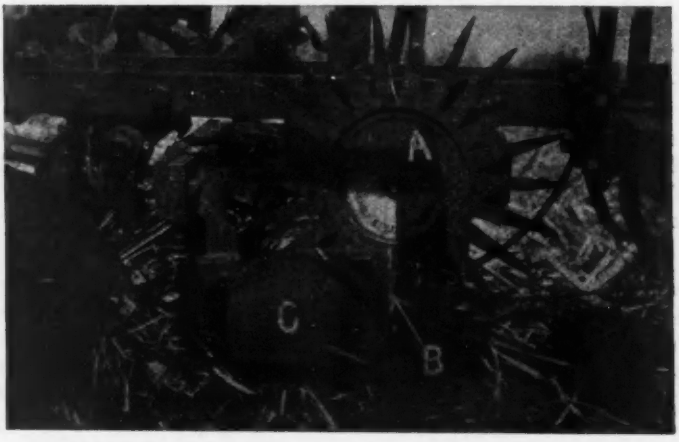


Fig. 12.—Showing the Essential Features of the Trash Cutter.

The cutting of the trash is effected by a star-wheel (A) and fixed knife (B) which are attached to the plough frame just ahead of the disc. As the implement moves forward the star-wheel revolves, and the points effectively pin the trash to the soil surface, when the sharp knife shears the trash and tops into lengths equal to that of the plough-cut width. The short lengths of trash are guided into the preceding furrow by the small mouldboard (C), to be effectively covered by the next plough slice.

Fig. 13.—Illustrating the Effective Work Performed by the Attachment.

The attachment was demonstrated to the overseas sugar-cane technologists on the occasion of their visit to Bundaberg. The excellence of the work which was being performed is demonstrated by the accompanying illustration (Fig. 13). It will be observed that scarcely a blade of trash is evident on the ploughed section of the block. The soil type was red volcanic loam.

H.W.K.

Meeting of Sugar Experiment Stations Advisory Board.

A MEETING of the Sugar Advisory Board, consisting of the Honourable F. W. Bulcock, Minister for Agriculture and Stock, Messrs. W. F. Seymour Howe, John Smith, B. Courtice, and H. W. Kerr, took place at the Mulgrave Mill office on 13th September, 1935, under the Chairmanship of the Minister. An apology was received from Mr. W. D. Davies who was unavoidably detained in Brisbane.

The principal business transacted dealt with pest control. The Board decided to convene a Conference consisting of representatives from each mill district, to meet Mr. Bell in Townsville at an early date to discuss pest problems, and to endeavour to arrive at a satisfactory unified basis of pest control.

Some discussion took place concerning the manufacture of yeast and the general utilisation of mill by-products. It was intimated by the Chairman that members of the Council for Scientific and Industrial Research have made intensive investigations as to possibilities in this direction, and are preparing a report on the subject. Also, the British Chemical Industries were supplying to Mr. Seymour Howe comprehensive details concerning their experience and activities. These reports will come before the Board at its next meeting, and will be the subject of further consideration.

Preliminary discussion took place on the approaching appointment of a consulting Mill Engineer to the Bureau Staff, and the Board, after deliberation, called Dr. Honig into conference. Dr. Honig is Director of the Java Sugar Experiment Station, and attended the Fifth Congress of the International Society of Sugar Cane Technologists. It was reported that matters are progressing quite satisfactorily in connection with this appointment, which it was hoped would be finalised when the Board meets again. Consideration was given to the question of training juniors for the higher executive positions of the Bureau staff, and it was decided that a cadet recruited from the Queensland University should be attached to the successful applicant in order that he may gain a comprehensive knowledge of sugar mill engineering technology.

Dr. Kerr furnished a report on the recently imported toads domiciled at Meringa, and the Board was pleased to learn that these toads are now breeding in captivity. The Director of the Sugar Experiment Stations informed members that this is the first recorded instance of toads of this variety breeding in captivity.

The Board expressed its unanimous appreciation of the action of the Government in connection with the visit of the overseas sugar technologists, and were also deeply appreciative of the splendid manner in which the delegates had been received and entertained by the various sugar organisations and local committees throughout the State. This visit had proved of enormous value to the industry, as much had been gained from the views of the several delegates.

The meeting of the Sugar Advisory Board at Gordonvale represents the Board's first sitting in the North. Meetings have taken place in Brisbane, Bundaberg, and Rockhampton, and with the Northern meeting most of the sugar districts in Queensland have now been visited by the Board, in accordance with its policy to meet in the various sugar centres of the State.

"Cotton King" Attachment.

Canegrowers are generally agreed that the "Cotton King" disc cultivator is very severe on the horses employed to operate it; and those farmers who study the comfort of their animals will be interested in the accompanying photographs of a device which is employed in the Cairns district.

Fig. 14.—Showing the Construction of the Cross-bar.

Fig. 15.—Illustrating the Method of Attachment to the Pole.

The weight of the implement is carried by a 6-feet length of 3 in. x 1½ in. hardwood provided with two slots each 2 ft. 2 in. long and ¾ in. wide. This is fitted to two spikes with which the saddles are provided, and is attached to the pole by means of a length of chain. The arrangement is quite simple and very effective.

G.B.

Laboratory Testing of Soils.

By H. W. Kerr.

THE most direct and best method of determining the fertilizer requirements of the soil is that of the field trial. Most canegrowers are acquainted with the farm fertility trials which have been conducted throughout the sugar areas during the past six years, and the results derived therefrom have been of great benefit to the farmers participating in the work. But this method is laborious, and the number of such trials that can be carried out effectively each year is decidedly limited; in addition to his other duties, from 15 to 20 trials will ensure a busy year for one field officer.

Attempts have been made to devise laboratory soil tests whereby it may be possible to gauge correctly the plantfood deficiencies of the soil by a rapid chemical method. To establish the value of any test requires years of careful comparison between the laboratory results and actual field experience. This project has been pursued by the Bureau since the inauguration of the farm trials, and it is pleasing to report that we feel confident that we are able to give growers a reliable recommendation regarding the phosphate needs of the land, simply on the basis of our chemical test. With regard to potash, the results are not so convincing, and further investigation is required.

We are very interested at the present time in a pot test method which has been under trial in Hawaii for several years. The method consists, briefly, of filling a number of small earthenware pots with the soil under review, and adding varying amounts of plantfood, according to a pre-determined plan, to certain of the pots, after which they are sown with Sudan or Panicum grass. The yields from the respective pots at maturity are then used to calculate the requirements of the soil with respect to potash and phosphate. It is, really, a miniature "farm" trial, in which pots take the place of plots, and cane is replaced by a selected grass.

It is claimed that the results are proving of very great value in enabling reliable plantfood recommendations to be made. It is interesting to note, also, that the method gives most reliable results with respect to potash, and if Queensland experience should confirm this, we would have at our command satisfactory methods for the determination of both phosphate and potash deficiencies.

Now that a glasshouse is available at Meringa, the possibilities of the method will shortly be tested. In the near future, similar facilities will be provided at the Mackay and Bundaberg Stations, and the work will be extended to those centres if early results suggest that the method is trustworthy.

It is rather significant that in no cane country has a satisfactory test for nitrogen deficiency been formulated, excepting, of course, the

direct field trial. It is generally recognised in Queensland that practically all cane soils are in need of this plantfood—particularly for ratoon crops—and farm trial results to date enable us to recommend, with a high degree of confidence, a suitable application of this plantfood under varying conditions.

Cane Trash and Soil Organic Matter.

A VALUABLE contribution on this important topic was presented at the recent International Conference of Sugar Cane Technologists by Mr. C. R. von Stieglitz, of the Bureau staff. This paper embodied the results of a laboratory study designed to demonstrate the influence of heavy additions of trash to the soil, as it affects both the physical condition and the fertility of the land.

The trash was added to the soil in a finely-crushed state, and soil moisture conditions were so regulated as to ensure a rapid rotting of the material. The amount added during the course of six months was equal to the trash and tops which would be derived from 200 tons of cane per acre. By introducing this exaggerated effect, it was possible to gain some idea of what would happen over the course of several years under normal field conditions.

It was found that a very pronounced increase in soil fertility was effected by the treatment, showing that the plantfoods bound up in the trash were readily liberated as the material decomposed. An interesting aspect was the marked increase in soil nitrogen; the gain to the soil was greater than would be expected from the analysis of the trash, showing that by feeding certain groups of soil bacteria with carbohydrate food they were stimulated to absorb atmospheric nitrogen and combine it into a form available to the cane crop.

Contrary to popular supposition, the rotting of the trash rendered the soil less acid than before, and not more so. Farmers often express the opinion that organic matter will make the soil sour, necessitating an application of lime to correct this defect.

The physical condition of the land was very definitely improved by the trash addition. This was reflected in the improvement in the available moisture capacity of the soil, which in the case of the red volcanic loam, was increased by 17 per cent. Other tests showed that the structure of the soil had been appreciably "opened up" by the trash treatment, thus rendering it more readily absorptive of moisture and increasing the ease with which a condition of good tilth might be created and maintained.

H.W.K.

Official Opening of Northern Sugar Experiment Station, Meringa.

THE official opening ceremony of the new Sugar Experiment Station at Meringa was performed by the Honourable the Minister for Agriculture (Mr. F. W. Bulcock) on the afternoon of Friday, 13th September, 1935. The Experiment Stations Advisory Board and visiting delegates to the International Sugar Technologists' Conference were present, in addition to a large gathering of local farmers and prominent townspeople.

In a brief address of welcome, Dr. H. W. Kerr (Director of the Bureau of Sugar Experiment Stations) said that the day was a happy one for the Advisory Board and officers of the Bureau staff, as it marked the realisation of a long cherished hope that one day all sugar experimental work in North Queensland would be concentrated at one station. Meringa, he suggested, was admirably suited for this purpose.

Dr. Kerr said it was most appropriate that the Minister should be with them on this occasion, for Mr. Bulcock was largely responsible for the consummation of the plan, and he knew that the Minister would at all times continue to manifest a sincere interest in the activities of the Station, and to lend his keenest co-operation. He had therefore very much pleasure in inviting the Minister to address the gathering and to declare the Station officially opened.

The Minister said it was indeed a pleasing occasion to those who were associated in any way with the sugar industry. This Experiment Station was urgently needed. Up to eighteen months ago, the development of the cultural and plant breeding work had been carried out at South Johnstone, while entomological studies were made at Meringa. The possibilities of any further material advance in our knowledge regarding cultural treatments of the alluvial lands of the Johnstone River were remote, while the red schist soils of the Meringa area demanded intensive study. Moreover, the establishment of one central, highly equipped station, would make for economy in operation and improved efficiency.

In all their endeavours, continued the Minister, they had the ardent support of the Sugar Advisory Board; and it would be admitted that they had co-operated to make the Meringa Station not only the outstanding station in the North, but in Queensland generally. He thought that the establishment of this Station would make a very definite contribution to the welfare of the sugar industry—not only in Queensland but in a very much wider sphere. The knowledge that was obtained here would be of value to sugar growers and experimentists in other parts of the world. They appreciated to the full the value of co-operation, continued the Minister. There was probably no other industry in Australia that would profit to so great an extent by virtue of co-operation and mutual support of those engaged in it, as the sugar industry.

Fig. 16.—General View of the Northern Experiment Station, Meringa.

One thing they required above all was the co-operation of the Government. Under the financial readjustment plan which had been effected when the Sugar Experiment Stations Act was recently amended, the Government contributed £7,000 annually towards the cost of maintaining the Experiment Stations. The balance of the money was found by the industry. Whenever anything untoward had developed, the industry had always discharged its obligations in the best possible manner—by bearing its fair share of the financial costs. The Advisory Board, which was constituted of industry representatives, was therefore charged with a very definite responsibility and he could say that they had discharged it admirably.

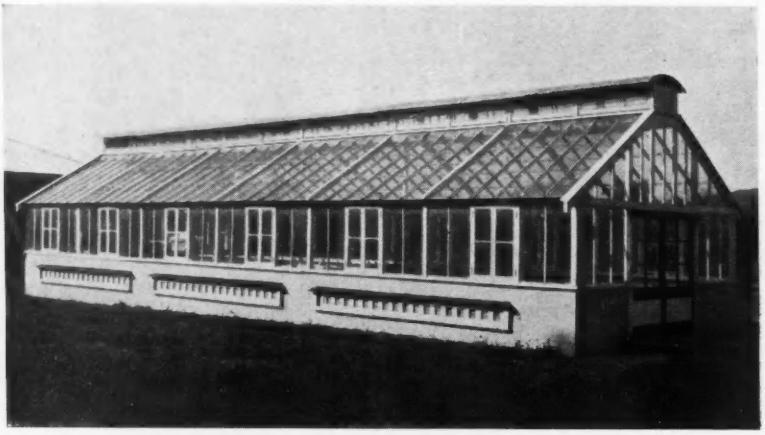


Fig. 17.—The Glasshouse which is Used in Seedling Work.

The Advisory Board consisted of two millers' representatives, one from the north and one from the south, and two growers' representatives, also from the northern and southern cane districts respectively. It was provided that one of the millers' representatives should be nominated by the Queensland Society of Sugar Cane Technologists.

A fact that pleased the Minister was the thorough manner in which the Board carried out its policy—"second best" was not good enough, the best and only the best was their policy. This applied not only on the investigational side of the work, but also on the question of manning their staff and recruiting of their officers. Only that morning the Board had made an important decision regarding the appointment of a University trainee. The Board was certainly making an excellent contribution to the wellbeing of the sugar industry.

Referring to recent advances in knowledge, the Minister stated that such advancement could never have resulted had it not been for those who made a scientific study of the problems confronting them. For that reason, he was particularly pleased to welcome the visiting

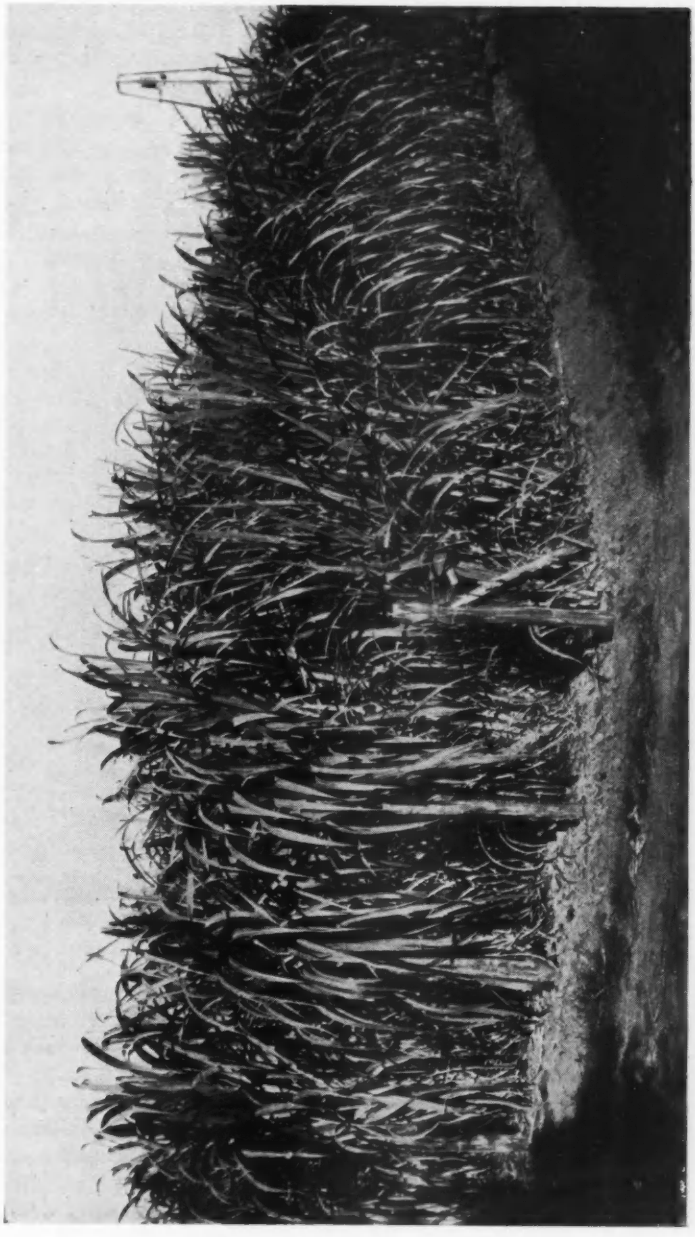


Fig. 18.—A Block of New Seedlings at Meringa.

technologists who were present that afternoon, at the forging of a new link in the chain of sugar knowledge, a link which, adjustable with those links at Bundaberg, Mackay, and Brisbane, was likely to provide the knowledge so essential to the progress of the industry.

The Minister paid a tribute to the excellent work of the staff of the Experiment Stations, and remarked that first-class brains were wanted to tackle the problems which confronted them. They sent their officers overseas for training whenever practicable, and in addition, when they found a man with outstanding qualities they endeavoured to give him every opportunity to develop. They could all feel assured that the domestic harmony within the organisation would allow the best results to be accomplished. They were well aware of the many problems

Fig. 19.—Exterior View of Pond and Cage Constructed for the Reception of a Colony of the Giant Toad *Bufo marinus* Introduced from Hawaii.

which they had to face and were not victims of the illusion that the sugar industry was a cornucopia from which wealth might be poured at will. However, the sugar industry on the experimental side was one which he thought was more efficient than ony other agricultural industry in Australia. The price of the preservation of the industry was the maintenance of the very highest standards of efficiency, and if they did not practise that efficiency in and out of season, the price of sugar would be much greater than it is at the present time.

Mr. Bulcock made a trenchant attack on those organisations which, fortified with a colossal ignorance, were prepared to come forward and criticise the sugar industry. Presumably they derived some satisfaction from their criticisms and perhaps it was not for him to deny

them their pleasure; but he would like to say that the Queensland sugar industry was not the wealthy industry they in their ignorance believed it to be. The income of the average sugar farmer was generally little better than that of the average artisan, and the risks associated with the industry were such that it was a hazardous occupation indeed.

Mr. Bulcock, concluding his address, said that he was particularly delighted, as Minister for Agriculture, at having the opportunity of opening the Station at Meringa. Two years ago he visited South Johnstone and Meringa, and decided that the centre of activities should be transferred to Meringa. Wonderful progress had been made since that time, and this Station, he thought, would make a very definite contribution to the economic preservation of the industry in North

Fig. 20.—Interior View of Toad Pond Showing Spray and Growth of Water Hyacinth.

Queensland. He was sorry that the Station was not in "full blast" that day, to allow the visitors to see the work for themselves. He assured the overseas delegates that their visit to the North and the contributions they had made to the industry would not be forgotten. So long as they had the guidance of the Advisory Board backed up by the present Bureau staff, he felt the work would progress. They were in process of formulating a long distance research programme, and when this was carried out, research would still continue. He had infinite pleasure in declaring the Meringa Sugar Experiment Station officially opened.

A vote of thanks to the Minister was moved by Mr. Ben Courtice, growers' representative on the Experiment Stations Advisory Board, who referred appreciatively to the work which the Premier and the Minister for Agriculture had performed on behalf of the sugar industry.

The Sugar Exhibit at the Brisbane Jubilee Show.

The exhibit by the sugar organisations, in collaboration with the Bureau of Sugar Experiment Stations, was justly regarded as being one of the outstanding displays made at the recent Royal National Show. It occupied the whole of one side of the Agricultural Department Court in the main pavilion. The accompanying photograph gives a general idea of the arrangement, but owing to the difficulty of obtaining an unobstructed position for the camera, the photograph fails to include all the features which contributed to the attractiveness of the

Fig. 21.—General View of the Sugar Exhibit at the recent Brisbane Show.

exhibit. The main feature was to show all the many phases of the production of sugar from the preparation of the land to the final despatch of the refined sugar to the consuming centres. On a model farm was shown a field being cultivated with a tractor-drawn plough, an adjoining field with the just germinated cane appearing through the ground, then other fields with the cane in different stages of growth. Finally was shown the harvesting of the mature crop, the loading of the cane on to trucks and their despatch to the mill. The next section showed the raw sugar mill. The scale model of a modern sugar mill,

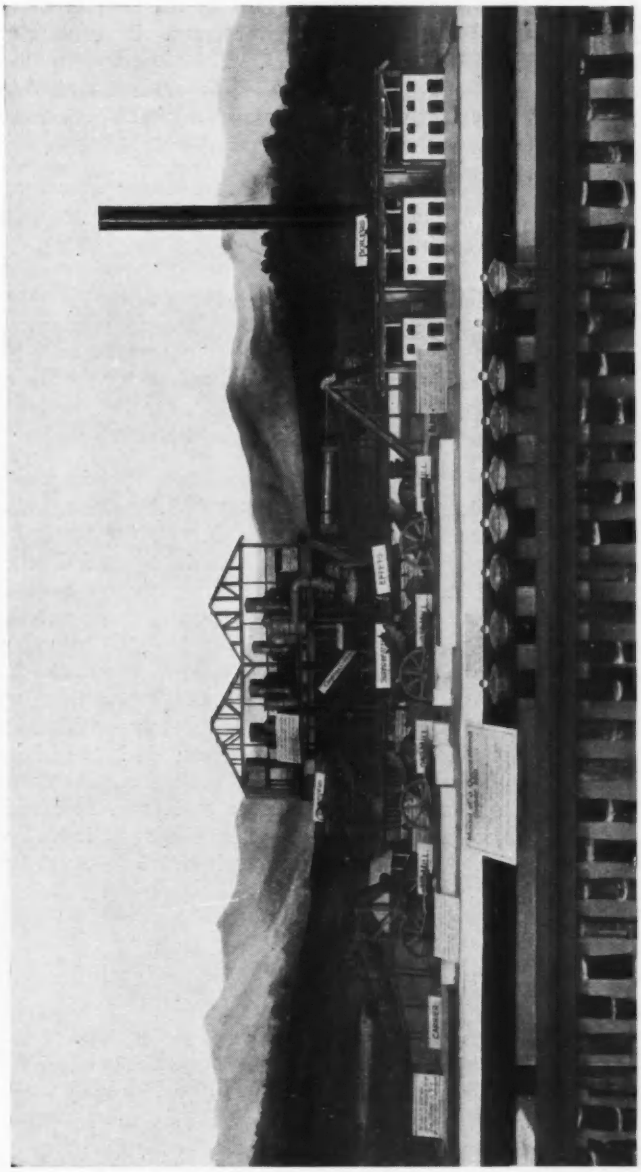


Fig. 22.—A Working Model of a Queensland Sugar Mill.
Built to scale, this miniature mill was one of the main features of a very fine sugar exhibit that attracted great public interest daily throughout Show week.

which attracted so much interest and attention at the previous show, has had many details added since that time and is now wonderfully realistic and complete. The cane was shown coming to the carrier on trucks and a pile of bagged raw sugar on the sugar room floor gave

the finishing touch. Further along was shown an exterior model of a sugar refinery appropriately placed on a river front. Proceeding still further, a model distillery was represented. The models were set in unbroken sequence and merged into an artistically painted background conveying a typical rural setting for the farm scene, but appropriately taking an urban setting for the refinery.

On the left-hand side panel, the Bureau of Sugar Experiment Stations displayed the various type soils characteristic of the sugar districts, and also charts showing the geneæology of the famous Java cane P.O.J. 2878, and showing further the lines of breeding of the Queensland cane S.J. 878, which is a cross between Queensland-bred canes and P.O.J. 2878. On the right flank of the main exhibit was an artistically arranged pool with moonlight effects. Here were to be seen a number of the giant toads which were recently imported by the Bureau in the hope that they may be effective against the greyback beetle, the larva of which is the major insect pest of the Queensland canefields.

The whole exhibit was framed in sugar-cane arranged in massive pilasters supporting arches, over which was a map of Australia done in refined sugar, the location of every mill and refinery being marked by small coloured electric lights. Samples of all mill, refinery, and distillery products were displayed in attractive containers, while cards conveyed many of the striking facts and figures concerning the sugar industry. Many thousands of visitors thronged the exhibit, and the attendants were required to answer an almost continuous volley of questions. The desire thus shown to acquire information was gratifying to those who laboured to make the exhibit a success, and it cannot be doubted that such an exhibit must be a powerful educational force. It is to be hoped that the attractive presentation of the true facts of the industry will serve to remove some of the misapprehensions and prejudices which unfortunately exist in some quarters in regard to the sugar industry—the greatest of all Queensland's agricultural industries.—*Australian Sugar Journal.*

Cheap Fertilizers.

In no phase of agricultural practice is the farmer so liable to exploitation as in the purchase of fertilizer, unless he adheres to the policy of purchasing only from a reputable firm, and insists that the labelling of the product is in accordance with the requirements of the Fertilizer Act. Just recently we received a sample of "cheap" fertilizer which a cane-grower had purchased; on analysis it proved to be a fairly good grade of common salt, but it was, of course, quite valueless from his point of view.

H.W.K.

Memorial Cairn to Sugar Pioneers.

ONE of the most notable events in the history of the Queensland sugar industry was the Fifth Congress of Sugar Cane Technologists held in Brisbane during August-September. To commemorate the occasion, and to pay a fitting tribute to the pioneers of the industry, a memorial cairn was erected in the grounds of Ormiston House, formerly the home of the Hon. Louis Hope, who first manufactured sugar on a commercial scale in Queensland.

Fig. 23.—The Memorial Cairn at Ormiston.

In the presence of a large and representative gathering which included the visiting technologists, the Premier of Queensland (the Hon. W. Forgan Smith, M.L.A., LL.D.) performed the unveiling ceremony on the afternoon of Sunday, the 1st of September. In the course of his address, the Premier said:—

"We are assembled to-day to pay tribute to the pioneers of the great sugar industry who, some seventy years ago, began the manufacture of sugar in Queensland on this very spot. It is indeed a high tribute

that the leading sugar technologists of the world, the leaders in the industry, and so many of you people should gather here to-day to pay honour to the Hon. Louis Hope and those who were associated with him in the cultivation and manufacture of the first sugar in Queensland.

Fig. 24.—The Honourable the Premier (Mr. W. Forgan Smith) Addressing the Gathering.

"In 1865—but six years after Queensland's separation from New South Wales—Louis Hope erected the first sugar mill in Queensland, at Ormiston. A year or so before this he had cultivated 20 acres of sugar-cane. It was in response to an offer by the London Society of Arts of a medal for the first ton of sugar manufactured in Queensland that Louis Hope set up a mill, crushed his own sugar, and won the honour. As a result of his enterprise, there were 2,000 acres of land under sugar-cane the next year, and three years later twenty-eight sugar mills were operating in Queensland, manufacturing more than 2,000 tons of sugar.

"These are the first chapters in the romantic story of sugar in Queensland.

"In those early days the methods were necessarily crude. Both cane production and sugar manufacture were in their infancy, and the

industry had not as yet the benefit of the knowledge and the research of the sugar technologists who have lifted the industry from primitiveness to culture and high-grade efficiency.

"We pay tribute to those pioneers—first for their enterprise, and next for their courage, and last, but not least, for their achievement; it is difficult for us to-day to appreciate the immensity of their task. Faced as they were with obstruction on every hand, they applied those well-known qualities of determination and endurance to a task and achieved success.

"It is very doubtful whether in recent years many Australian industries have improved their efficiency as much as has the Queensland sugar industry. This is something of which you—the men and women of the industry—have reason to be proud. In the year 1900 ten tons of cane were required to manufacture one ton of sugar. In 1910 the tonnage was reduced to 8·73, in 1920 to 8, and in 1929 to 6·91. The brains of the technologists have been available also in the increase of production of cane per acre. In 1900 an average of 11 tons per acre were crushed for a yield of 1·20 tons of sugar. In 1929 the crushing was 16 tons per acre for a yield of 2·41 tons of sugar—double the former quantity.

"However, efficiency has not been limited to production and to crushing. In the refinery section, Australian refineries are working with lower process losses than those elsewhere, and it is claimed that in the matter of fuel value and economy there is no greater efficiency in other countries than there is in Australia.

"These results have come because of the efforts of the pioneer chemists and engineers, and are part of the technologists' contribution to the welfare of the industry.

"Queensland has a big stake in sugar. The sugar belt extends for over 1,200 miles, from Mossman in North Queensland to the banks of the Tweed River, and every ton of sugar is produced entirely by our own labour. The sugar industry is a lesson to the world in organisation. Every stage of sugar is efficiently organised. The interests of the grower, the worker, the miller, the refiner are alligned, and each is assured of sufficient remuneration to enable all to live according to the best Australian standards. We are the only country in the world handling tropical production with such success.

"Let us pause for a minute to look at some of the milestones in Queensland's sugar history. We find that—

In 1878 the sugar mills increased to 68;

In 1885 the genesis of the central mill system led to the erection of the Racecourse and North Eton mills;

In 1893 the Sugar Works Guarantee Act was passed;

In 1898 it was decided to establish a sugar experiment station at Mackay;

In 1904 the Bureau of Central Sugar Mills was set up;

In 1907 the Australian Sugar Producers' Association was launched;

In 1913 the Excise and Bounty Act was repealed;

In 1915 the first Sugar Cane Prices Act was passed;

In 1920 the Sugar Agreement was signed, resulting in the price per ton of cane being fixed at £30 6s. 8d.;

In 1929 the Queensland Society of Sugar Cane Technologists was inaugurated; and

To-day, the Fifth Congress of the International Technologists held in Brisbane, concurrently with the dedication of this memorial cairn.

"That same foresight which has marked the general control of the sugar industry has gone to the setting-up of this cairn, which is to be a memorial to all the sugar pioneers of Queensland. The granite of which it is constructed has been taken from three of the important sugar-growing centres—Cairns, Herbert River, and Giru—and the building of the cairn is in itself interesting. The base is of unworked stone, typifying the pioneer days. Rising to the base of the shaft, we find the stone partially dressed, typifying progress, whilst the capping stone is machined, symbolising the present efficiency of the industry.

"To-day we are being told to produce less. That is paradoxical in a world where there is clamour for food for the hungry. I trust that something of the same efficiency which has been the guiding star in the sugar industry will eventually find its way into the economic councils of the world, and that ultimately men and women will be permitted to enjoy to the full the fruits of the soil, and to share in the bountifulness of nature and the full production of industry, such as the sugar industry. If we do that, we will fulfil the great destiny which is ours. We will be true to the heritage of those early pioneers who pointed to us the way to success.

"I thank the International Society of Sugar Cane Technologists for the invitation to unveil this memorial cairn to-day. I pay tribute to the organisation which aims to promote production in both field and factory, and which so enthusiastically and efficiently has set about improving conditions in the sugar industry. I have very much pleasure in unveiling this memorial cairn, and paying my humble tribute to the memory of those sugar pioneers who built so nobly and well."

Mr. W. G. Gibson, managing director of Messrs. Gibson and Howes, Limited, expressed appreciation of the memorial on behalf of the pioneers, and Senator T. A. Crawford (Australian Sugar Producers' Association) and Mr. Geo. Johnson (Queensland Cane Growers' Council) responded on behalf of their respective organisations.

Donkey and Mule Breeding.

By H. J. Freeman.*

Introduction.

WHEN in conversation with Colonel Monsees, America's foremost jack and jennet breeder and owner of the Limestone Jack Farm situated at Smithtown, Missouri, he informed me of the following facts regarding the present conditions of the jack industry in America and also of the necessity for the observance of certain characteristics peculiar to this type of stock if successful mule breeding is to be accomplished.

Colonel Monsees said that the production of suitable jack stock is exactly the same task as the breeding and raising of any other kind of valuable livestock, and it can readily be understood that good jack stock is positively of vital importance for the foundation of mule breeding. At present there is a very serious shortage of jack stock in America as well as throughout the rest of the world. The mule market is particularly bare, and I witnessed a contract entered into by the Mexican Government with Colonel Monsees commissioning him to purchase 300 yearlings to two years old of specific type at the rate of 250 dollars (£50) per head. This will clearly demonstrate the present shortage so appreciably acknowledged throughout the United States of America.

From figures presented by Colonel Monsees, I ascertained that at present there are ten jacks in the United States of America to every jennet; nine out of every ten of these jacks are more or less faulty, and at present are over ten years of age. It is evident that the majority of these jacks will die within the next ten years, and from my own observations, backed up by Colonel Monsees' valuable experience, one can realise the scarcity of the young jacks so necessary to take the place of those rapidly passing into decline. It is estimated that if every jennet of breeding age were immediately bred to a suitable jack, at least fifteen years would be required to build up a sufficient supply to satisfy the present demand in America alone.

During the sixty years that Colonel Monsees has been breeding jacks two definite periods of depression have made themselves felt, and the present shortage can be attributed largely to the last lapse of depression which occurred during 1928 and 1929. It was of such a serious nature as to dishearten completely the jack breeders of America, compelling them in many instances to dispose of their stock at such prices as to make the business a disastrous venture. From 1929 onwards only the old established breeders possessed sufficient confidence to persevere

[*Mr. Freeman recently visited the United States of America for the purpose of studying methods of fruit production and marketing in that country. Through the courtesy of the Minister for Agriculture, he was commissioned to select three good quality jack donkeys on behalf of Queensland breeders, to be used in the production of draught mules for cane cultivation work. The above article should prove of particular interest to those engaged in this project.—Ed.]

in the expectation of better times ahead. Their anticipation has now proved a reality inasmuch as during the early months of this year buyers came from Spain, South Africa, India, and Mexico in an endeavour to buy suitable jack stock and mules for those countries. The main fact behind this particular period of depression as far as the jack breeders were concerned, was the positive trend towards mechanisation of all phases of agriculture. This particular move was apparently not capable of providing the actual results that were anticipated, for farm

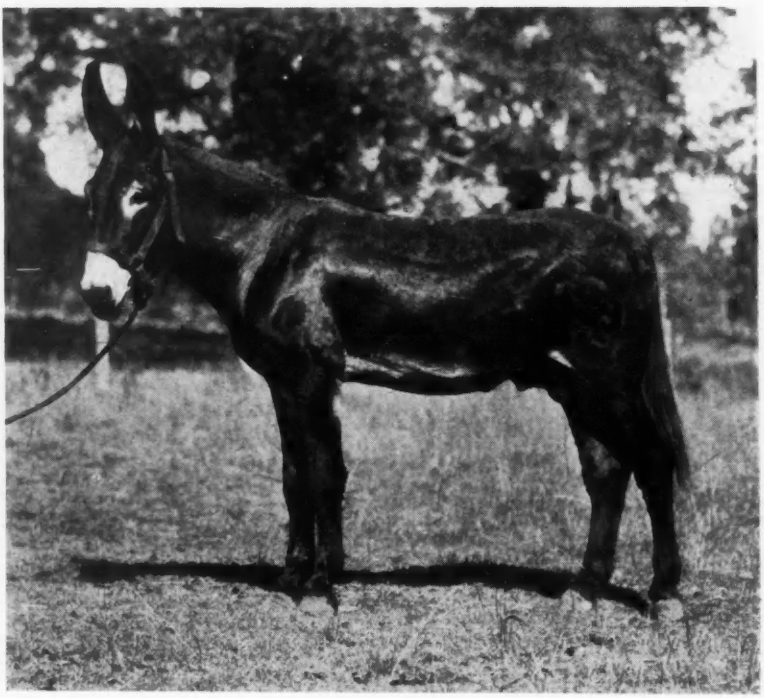


Fig. 25.

"Collay," the registered Jack purchased from Messrs. H. T. Hineman and Son, of Dighton, Kansas. This Jack is 15.1 standard measurement, and was foaled in 1928. He has sired many mules of excellent type, and was a noted Jack in the Mid-Western States of America. He is one of the best muscled and boned Jacks that has ever come out of America. This Jack was purchased for the Fairymead Sugar Coy., of Bundaberg.

hands as well as many stock-breeding farm owners were prevented by the disappearance of animals from earning a living, as can be very easily understood. Immediately the raising and working of horses and mules was abandoned, the market commenced to fall and finally crashed, when stock previously worth hundreds of dollars was passed in for values so low as have never been encountered before. Unfortunately, it can truthfully be recorded that many of these men who in those years

decided that motive power of the latest type was apparently of vital necessity for those times, are now walking the road, and thus enlarging the army of unemployed.

Donkey Breeding.

I was advised that the principles of the Jack Association of America have been strictly adhered to and that whenever possible one should not consider any other than registered stock. I was next advised that jennets should not be bred until they are at least three years old. They should be tried with a jack, the method being to lead him around in the yard or paddock within which the jennets are enclosed and if any of

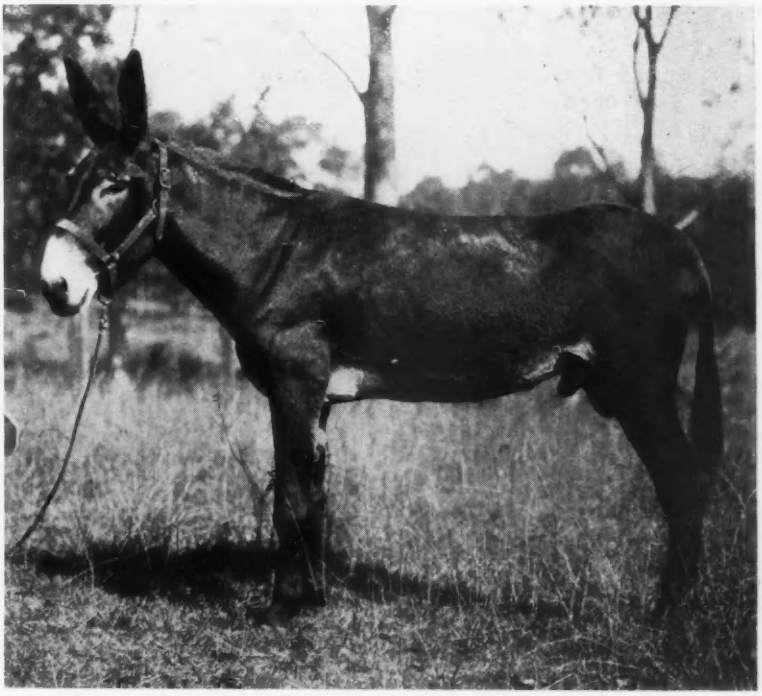


Fig. 26.

"Business," the registered Jack purchased from Colonel L. M. Monsees and Sons, of Smithton, Missouri, bred on the Limestone Valley Stud Jack Farm in that district. This Jack is 15⅜ hands standard measurement, and was foaled in 1929. He is a noted sire, and is renowned for the action and natural spirit of his progeny. This Jack was purchased for Messrs. P. F. King and M. Ahearn, of Home Hill.

them are in season it will readily be noticed by that particular animal's actions. A jennet in season should be separated from other stock and put in a safe box stall and there left for a day or a night. She should be bred and kept in the stall or in a secure separate pasture away from other stock until she becomes quite normal. She should then be turned back with the jennet herd and should be again tried in from eighteen

to twenty-one days. If necessary, the jennet should be bred again and handled as abovementioned. It is necessary that the jennet be handled in this manner throughout the entire season which, in America, continues from the first of April to the end of November. The practice is to observe the herd carefully, and, even though they may all appear to be in foal, a trial should be made every ten to fourteen days so as to

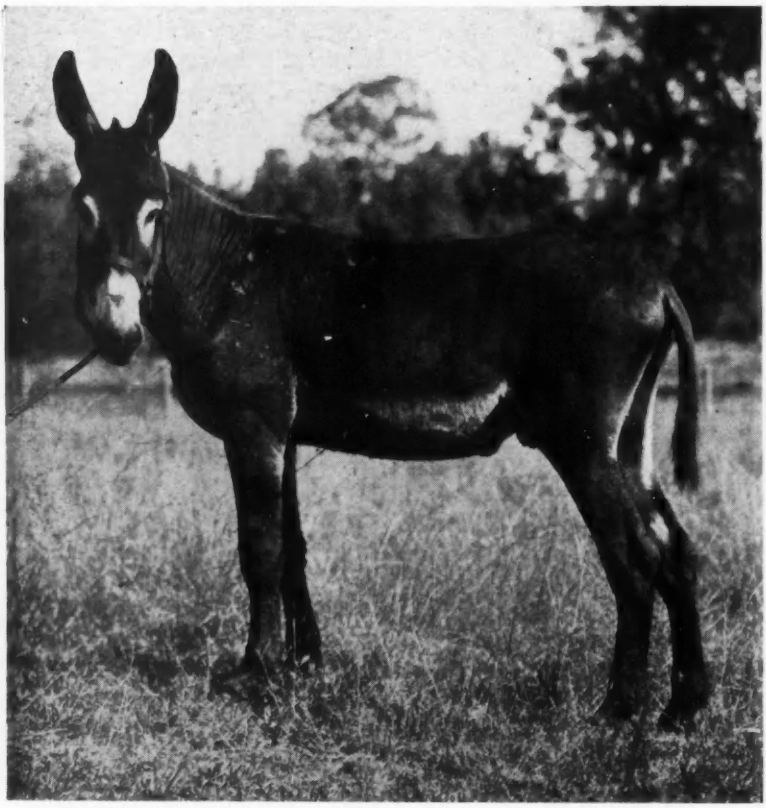


Fig. 27.

"Ajacks," the registered Jack purchased from Colonel L. M. Monsees and Sons, of Smithton, Missouri, bred on the Limestone Valley Stud Jack Farm in that district. This Jack was foaled on the 24th July, 1933, and, coming from excellent stock, should grow into a very desirable animal; being as yet a baby, he will grow considerably, and it is fully expected that he will sire mule stock that will be the most desirable.

eliminate the risk of a poor percentage of foals. Jennets are harder to settle than mares and only by careful attention will a heavy percentage of foals be obtained. These animals carry their young for twelve months or slightly longer, and should a jennet foal late in the autumn it would not be advisable to breed her again until the next spring.

Practice has shown that jennets should be very carefully watched at foaling time, and therefore they should be treated in such a manner as to make them content and easy to handle should they require any assistance at this particular period. As soon as the colt is foaled one should be very sure that the enveloping membranes do not cover its head and nose, for if this matter is not loosened in foaling, the colt may smother within a few minutes after birth. To avoid infection, the navel should be painted with iodine, and all natural functions should take place within three hours after the foal is born.

If a jennet is to foal in a box stall or a barn, these quarters should be perfectly clean, being first carefully disinfected to destroy any source of infection that may possibly be present. Although this is the practice adopted by many breeders, Colonel Monsees is very much in favour of allowing the stock to foal while running on pastures, particularly so if the weather is mild and all other conditions—good grass and water—are the order of the day. It has been noted that a colt foaled about mid-day with a temperature ranging around 100 degrees, and upon land that is carrying a depth of dust due to drought conditions, will usually die within two or three hours.

Care of the jennet while suckling the colt is an important matter and necessitates hand feeding if grass is not plentiful and succulent. Three to four quarts of oats twice a day is usually sufficient if the pasture is not all that it should be. Naturally a little hay to form a roughage basis is also necessary. It is surprising how very quickly the little colts learn to feed, bran and oats seemingly being their favourite diet.

For the owner of several colts, a creep pen or stall is recommended; the principle of this is that the youngsters can go in and feed at will while the older animals are kept out by the nature of the entrance. Most breeders wean their colts when they are from seven to eight months old, except where the jennet is not in foal; in that event the foal may be allowed to run with his dam for ten or eleven months. During the weaning of the youngsters, the jack colts should be separated from the jennet colts; in separating them, it is necessary to confine them to pastures well away from jennets and mules. It is important that a quiet natured young horse colt be placed with them until they are at least twenty to twenty-four months old. The reason for this is that a jack prefers the company of his own species, and if not able to associate with jennets, prefers the company of a mule to that of a horse. Running with a young horse has the definite action of creating a better relationship between the two classes of animals and prepares the jack for the work for which he is later to be used.

Mating with Mares.

At two years of age these young jacks will commence to assert themselves and, as a consequence, will have to be separated, otherwise they are liable to maim each other by the roughness of their play. As

with other classes of valuable animals, both jack and jennet colts should be well fed and cared for in a manner that all stock breeders of experience fully appreciate. One fact well worth recording is that by reason of the peculiar constitution of these animals, very little corn should be fed them; the heating effect of this grain bringing about disastrous results. Oats and bran with good hay are positive essentials for the producing of big strong stock.

During the summer when the young jack reaches twenty-four to thirty months of age he should be afforded an opportunity to serve a gentle mare definitely in season. This action should be accomplished by leading the mare slowly around the paddock and by observing carefully whether or not he is paying her the amount of attention that it is desirous he should. Let him serve her if he will and repeat for two or three days. If this young animal is eager to perform this function he will definitely be ready for use during the next season; he should be allowed fifteen to twenty mares, being then three years of age or a little older. Another fact well worth recording is that the mare should never in any circumstances be allowed to show her dislike for the jack by attempting to kick him or any such procedure. Should this occur it is very difficult to again persuade the jack to work. For this reason it is always advisable to place any mare that one wishes to have served by the jack in a small crush specially constructed for this purpose; the plan is to arrange the sides of the crush so that a satisfactory breeching can be placed behind the mare, thus allowing the jack free access without any risk of damage to either.

Bearing in mind the recommendation previously made regarding the definite separation of the young jacks from the young jennets or mules, it can be understood that great risk would be involved if one were to let any one of these young jacks associate with either younger or older jennets or mules. If this should happen he will thereafter possess a tendency to prefer these animals and will perhaps cease to work on mares.

Jacks in service should have at least one or two acres of grass in which to exercise. A jack at four or five years of age can be used twice a day, preferably early in the morning and during the latter part of the afternoon. During the breeding season, the jack's ration could consist of oats, pressed wheat and bran, and a liberal supply of good quality hay. Lucerne in quantity is not particularly recommended inasmuch as it has a somewhat depressing affect upon the kidneys. As is the case with all animals, a jack should have an abundance of fresh water and should never be fed more than he is capable of cleaning up at one feed. Many farmers only feed twice a day, morning and evening.

In the breeding of suitable mules, the following points should be observed. *Firstly*: The desirability of this particular beast for farm work; for the mule is the simplest and sturdiest of all draft stock to raise and handle. *Secondly*: Good mules are procurable not only from

registered mares but from any grade mare that possesses sufficient confirmation to make her a desirable dam. It has been proved that a mare sixteen hands and weighing twelve to fifteen hundred pounds, with a good body, neck and head, bred with a well developed jack of fifteen to fifteen and one-half hands high, will produce a mule weighing eleven to fourteen hundred pounds at three years of age. Draft mares weighing sixteen to eighteen hundred pounds and bred to similar jacks will produce mules heavier bodied and much bigger in the bone.

Colonel Monsees, through his experience, has proved that the best mules ever bred in Missouri were bred from mares of the standard trotting type and weighing about fourteen hundred pounds. The favourite jack would never measure more than fifteen to fifteen point two standard measurement. Bigger jacks than this are always faulty because of the amount of daylight they have beneath them, and the peculiar characteristic of being awkward and in every way apparently overgrown, always denoting a certain leg weakness not found in the smaller animals.

A mule colt if in a healthy condition and given a plentiful supply of feed can be weaned at seven months, but will never thrive so well if entirely separated as when paddocked or yarded with other babies of his own kind. Although under natural conditions a jack prefers a mule to a horse, the instinct of the dam predominates in the mule; as a consequence mules, whether colts or fully grown, prefer the company of horses to animals belonging to the species of the sire. A contented old mare makes an excellent stable or paddock companion for one or more mule youngsters. It is seldom that these youngsters need longer than three weeks to settle down after being taken away from their dam.

Experience has shown that the best age at which to commence working a young mule is thirty months, and then the work should be only light until the following season. With good feed, reasonable attention, and moderately heavy work, mules should continue to be valuable farm animals until they are fifteen or sixteen years of age.

Frost Damage in Cane.

By N. J. King.

In the Bundaberg district and those areas further south the incidence and severity of frosts become factors of importance in cane production. The winter of 1932 and of the present year provide a drastic example of what damage is likely to ensue from heavy frosts. It is an established fact that on frosty nights the lowest temperatures exist at the ground level, or in close proximity thereto. Cold air settles to the ground and therefore the lowest temperatures are recorded immediately above the soil—what is generally termed the "grass reading." As night

approaches and the surface of the earth begins to cool, heat is radiated from the soil into the atmosphere. The soil moisture removed by this radiated heat condenses on contact with the cooler air and is deposited as dew. On an open field—under bare fallow—the radiated heat is quickly lost in the atmosphere and any drop in temperature of the air causes a settling of the colder atmospherical strata to the soil level.

In a field of tall cane, however, the cane tops act as a blanket, preventing to a large extent the radiation and consequent loss of heat from the soil. The atmosphere within the cane block keeps warmer and moister than the bare fallow block and is therefore subject to a smaller drop in temperature. Added to this is the fact that transpiration processes in the plant itself produce a certain amount of heat and this heat assists in lessening the effects of any serious drop in temperature in the surrounding atmosphere.

With a view to determining the effect of growing cane on atmospheric temperatures it was decided during 1933 to record temperatures each night on the Bundaberg Sugar Experiment Station, at heights varying from ground level to 7 feet 6 inches. Six thermometers of the maximum-minimum type were attached to a pole, the first at ground level and then at 18-inch intervals so that the highest was at 7 feet 6 inches. Temperatures were recorded each morning. The thermometers were first placed on a bare fallow block and the following are some of the figures obtained:—

Date.	Height.					
	0 in.	18 in.	36 in.	54 in.	72 in.	90 in.
1933						
28th April	55	57	65	66	65	64
3rd May	55	57	57	56	56	57
15th May	55	55	55	54	54	54
17th May	48	49	50	50	50	50
20th May	46	47	49	49	49	50
24th May	54	57	58	55	54	54
27th May	47	49	51	51	52	53
1st June	36	36	38	38	39	40

Two outstanding points in the above table are (1) the influence of still nights, and (2) the effect of a shower of rain. On April 28 was recorded a very still night with no breeze; the difference of 11 degrees F. between the ground level and the 4 feet 6 inch level is really remarkable, illustrating in no uncertain manner the concentration of the cold air at the lower levels. On 15th May some 13 points of rain were registered and it is seen that on that night the lower level thermometer gave a higher minimum reading than the instruments higher up the pole. This latter observation supports the contention that crops on moist soils are less likely to be frosted than those on dry soils. Wet soils conduct heat better than do dry ones and consequently the radiation loss is more rapidly compensated for by conduction of heat from the subsoil;

also under moist conditions the lower atmosphere is highly charged with moisture and the greater condensation produces a ground mist or fog which acts as a protective covering against radiation loss.

To obtain definite figures to illustrate and confirm this contention the thermometers were removed to Bingera Plantation and set up on a pole in an irrigated block so that the lowest thermometer was 12 inches from the ground and the highest 10 feet. A member of the staff of Messrs. Gibson and Howes co-operated in taking daily readings of the thermometers. The following are some of the figures recorded:—

Date.	Height.					
	12 in.	24 in.	48 in.	72 in.	96 in.	120 in.
1933.						
8th June	53	53	54	51	53	52
10th June	52	51	54	48	49	49
17th June	53	53	52	50	50	51
21st June	42	41	39	37	39	39
26th June	35	35	33	32	32	33
27th June	36	36	33	32	32	33

It is noticeable that the temperatures below six feet (inside the cane) are notably higher than above the cane, and that a definite drop occurs at about the six-foot level. This illustrates the fact that the cold air settles on the cane tops as it did on the ground in the bare fallow experiment. Radiated heat from the soil, and heat of transpiration from the cane keep the temperature there above normal atmospheric figures.

The thermometers were removed once more and divided into two lots of three each. One set was placed as before within a cane block, and the other outside the block where normal conditions prevailed.

Date.	In Cane Block.			Outside Cane Block.		
	Height.			Height.		
	2 ft.	6 ft.	10 ft.	2 ft.	6 ft.	10 ft.
1933.						
26th July	51	52	49	48	53	54
27th July	45	44	41	43	44	46
28th July	45	43	42	40	43	44
1st August	43	41	39	42	42	43
5th August	39	37	35	37	38	39

These figures merely confirm what has gone before.

The difference between frost and no frost may be a matter of one or two degrees of temperature and if moist soil and a tall cane crop can make this difference of two degrees, light frosts may thus be

avoided. It is evident therefore that on lands of similar topography and growing the same variety, the irrigated crop is in less danger of frost damage than the non-irrigated one.

As the result of a few initial experiments it is thought—though by no means proved—that a trash cover on the ground surface may have a somewhat similar effect. During the winter of 1935 a soil recording thermometer was utilised to obtain some soil temperature readings. The instrument carried two thermometers and a complete record of variation in temperature was obtained on the chart. One thermometer was buried under 4 inches of soil and the other under 4 inches of soil plus the trash from the previous crop, which had been conserved in alternate interspaces. The accompanying diagram (Fig. 28) is copied from the recorder chart and shows the temperature of each thermometer at hourly intervals. Starting at 9 a.m., it is seen that the trash covered soil is warmer by two degrees than the bare soil. It remains warmer till 12.30 p.m. when the sun's rays heat up the bare soil, reaching a maximum at 5 p.m. at which time it is warmer by four degrees than the trash covered soil. At about 1 a.m., however, the bare soil becomes cooler than the trash covered, becoming some three degrees cooler by 9 a.m., and then begins to warm up again.

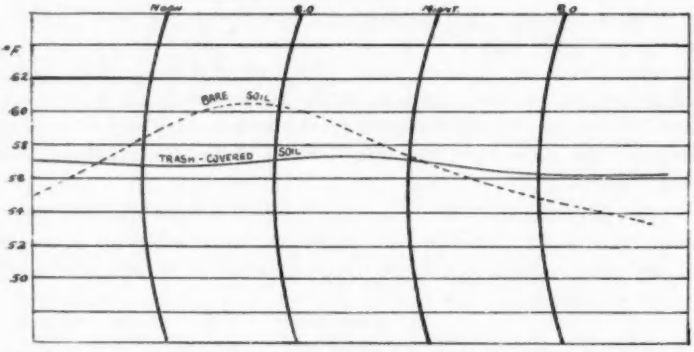


Fig. 28.—Illustrating the Daily Variation in Soil Temperature with Bare and Trash-covered Land.

The trash here is obviously acting as an insulating blanket preventing rapid radiation of heat during the night, and it may be supposed that this effect is similar to that of a wet soil. In fact, the soil under the trash was moister than the bare soil, and the effect may be due to moisture alone. No conclusions can be drawn at this stage, but as the opportunity arises further work will be carried out.

The lighting of smoke fires or "smudges" has often been mooted in South Queensland as a frost-preventive measure, and has been used extensively in other parts of the world (notably California) for frost prevention with fruit crops. Some years ago a very complete investigation into the value of smudges showed conclusively, in

California, that the smoke had no appreciable effect in preventing frost, and that their only value was the warmth given off by the fires themselves. An orchard entirely surrounded by smoke fires enveloping all the trees in a blanket of smoke did not have its atmosphereic temperature raised by 1 degree above that of the surrounding orchards. Experiments at the Mackay Experiment Station on a very small block of cane were favourable, but experiments on the Northern Rivers of New South Wales, on a 10-acre block, were a failure.

It may be pointed out that the degree of cold during a frost is not a true criterion of the damage one may expect. A thermometer reading of 27° (5° of frost) may only mean that the temperature reached that figure for an instant; and the total time that the thermometer registered less than 32° may have been only half an hour. Much more damage would be done by a frost when the thermometer fell only to 30° (2° of frost) but remained there for eight or ten hours.

SEVERITY OF FROST DAMAGE.

Under the most severe frost conditions in Queensland, such as were experienced at Wallaville this year, the leaves, growing point, and buds are all killed. The first indication of frost damage is revealed by slicing a stick of cane vertically, when it will be found that a sodden area occurs just above the growing point. This area turns brown after some forty-eight hours, when the "heart" can be pulled out of the stick. If the growing point be killed but not the eyes of the stick, side-shooting will proceed. Under the least severe conditions the leaves only are affected, assuming a sun-scorched appearance. The latter condition imposes a check on growth, but as soon as warm weather ensues new leaves develop.

FROST RESISTANT VARIETIES.

In a series of experiments recently carried out by the Colonial Sugar Refining Company in the Tweed River district, it has been recorded that there are four degrees of resistance to frost injury, depending on the variety. These are listed as follows:—

1. *Resistant in both leaf and stalk*—Co. 281, Co. 290, P.O.J. 979, P.O.J. 2379.
2. *Susceptible to leaf injury but of fair to good stalk resistance*—Q. 813, Badila, 26 C. 148, P.O.J. 100.
3. *Susceptible to stalk injury but of good leaf resistance*—P.O.J. 2364, P.O.J. 2727, P.O.J. 2878, P.O.J. 2883.
4. *Susceptible to injury in both leaf and stalk*—P.O.J. 2725, Korpi, Oramboo, Nanemo, S.C. 12/4, B.H. 10/12.

Entomology in Hawaii.*

By R. W. Mungomery.

BEFORE leaving Sydney on 3rd April, I took the opportunity of interviewing the Chief Quarantine Officer for Sydney, and arranged for the entry of the Giant American Toad, which project was to form one of my chief objectives in Hawaii. Proceeding to Fiji, where a day's stay was made, I was able to make a hurried trip to the Nausori mill, where I learned that Badila was still being severely damaged by the beetle borer, whilst the harder Malabar variety was standing up to its attack fairly well. Later, in Honolulu, I had the opportunity of meeting Mr. G. Windred, Entomologist to the C.S.R. Company, who confirmed this report, and mentioned that the control exercised by the Tachinid fly was extremely low and disappointing. Fiji disease was also seen in the fields, but by systematic roguing and the use of slightly more resistant varieties the disease was being brought under better control again.

Arriving in Honolulu on 12th April, I was met by Mr. Pemberton, Entomologist of the Hawaiian Sugar Planters' Association Experiment Station, who took me to the Experiment Station headquarters, and thereafter I was given the opportunity of studying any pest or other problem in which I was particularly interested. Most of my time was spent on the Island of Oahu, which afforded the threefold advantage of having the largest number of pests and parasites, it was furnished with a wide variety of climatic conditions, and in addition it was the headquarters of a large scientific staff, to whom I could refer for any information which I required. After two weeks in Honolulu, I travelled by Inter-island Airways, via Maui, to the island of Hawaii, landing at Upolu, and thence proceeding by car down the Hamakua coast to Hilo. Passing through this country, I was able to see cane growing under a variety of conditions, from the windy drier areas to those of heavy rainfall, whilst cane was being transported to the mills by flumes, by aerial cables carrying slings of cane, by locomotives hauling trucks as in Queensland, and by strings of waggons being hauled by Diesel tractors.

After a week at Hilo I returned to Honolulu, remaining there until my departure for Australia on 3rd June. On my return trip to Fiji I met Mr. Simmonds, Government Entomologist at Suva, who kindly took me to some native gardens where I was able to get a fresh supply of the pink sugar cane mealy bug, the host of a parasite which I was bringing back with me to Queensland.

The advantages of such a trip to a foreign country extend far beyond the mere study of an insect or animal in its natural habitat, for its proposed introduction into a new country. This, in itself, is

* This report outlines the observations of Mr. Mungomery during a recent brief visit to Hawaii. His comments should prove of considerable interest to canegrowers generally.—Ed.

of importance as one immediately gains a clear conception of the requirements of the problem, and this goes far towards making the introduction a success. Unless the special requirements connected with the breeding of the introduced insect or animal are fully understood, valuable shipments are liable to be lost before the necessary experience is gained. More can be learned by a few days' observation, and by the asking of a few judicious questions, than by weeks of searching for the same information from books.

Further, the investigator is able to see varied sets of economic conditions and appreciate why a form of control which may be successful in one country may not be applicable in another. In addition, he is able to study the methods by which problems are handled elsewhere, the technique and special equipment employed in this work, and also, he is usually benefited by being able to adapt some of these devices in the pursuit of his own immediate line of investigations. Finally, the contacts made with eminent scientific workers who have already "won their spurs" in the entomological world is something that cannot be estimated in pounds, shillings, and pence. One discusses his problems with them, obtains their ideas on lines of investigations or control, and is benefited by their vast experience gained through wide travels and varied associations. In this way confidence is strengthened.

The following notes on the status of the major pests, parasites, and predators associated with cane production in Hawaii are of interest, as they are of special importance to our own Queensland industry:—

Bufo marinus.

This Giant Toad was introduced into Hawaii three years ago with the idea of its becoming a general insect feeder, rather than for the specific purpose of subjugating any one pest. Already it has bred up to enormous numbers, but several years must yet elapse before it will have reached saturation point.

Most insect parasites are active during the day time, and as these toads are mainly nocturnal feeders, it was thought that the general parasite population will suffer very little as a result of this importation, while several beetles, centipedes, caterpillars, and other species which are active at night will fall victims to the toad. This is actually proving to be the case. In places where toads are numerous, very favourable reports are constantly being received concerning the good work which they are accomplishing. (A more detailed description of the toad, its feeding habits, and its possibilities in Queensland, has already been published in the Quarterly Bulletin, July, 1935.)

Anomala Grub.

Anomala grub damage formerly occurred over a small area in the vicinity of Waipio on the Island of Oahu. Ewa and Waipahu plantations suffered the greatest losses, but during the period of my visit no

grub damage was seen. Moreover, grubs were particularly scarce in land that was being planted or ploughed out, and diggings made in likely looking "grub patch" areas similarly yielded few or no grubs. This scarcity was due to a combination of causes. In the first place *Scolia maniliae,* which was introduced from the Philippines many years ago, still maintains a very high degree of parasitism, and kills off large numbers of grubs. These wasps were very plentiful, and were found flying over all *Anomala*-infested fields. During last year, *Tiphia* sp., which was introduced to Hawaii 17 years ago, was first recovered in the fields, and its numbers then were fairly plentiful. More recently, *Elis* (near *pulchrina*), which was introduced from Guatemala last year, was recovered in the field, so that with the possibility of these three wasp parasites operating against *Anomala,* wide variations in the degree of infestation should not be so marked in future. The predator, *Monocrepidius exsul,* can also be found in the red soils of this area, and lately a Guatemalan Elaterid, *Pyrophorus* sp., has also been liberated in the area to add to the array of *Anomala* enemies. Thus it will be apparent that an important parasite complex has been gradually built up around the *Anomala* grub, and what is most important, the bugbear of hyperparasites does not exist in these cases in Hawaii, so that the control that can be expected from their combined efforts should be high.

Another important controlling factor appears to be that of the arsenic treatment of infested soils. Although this practice has been in operation for only a few years, the treatment appears to have cleaned up some of the smaller patches of grub infestations, and a 300 lb. application of white arsenic per acre seems to give commercial control. It may be of interest to observe here, that is areas where up to one ton of arsenic per acre was applied to the soil, the up-take of arsenic by the cane stalks was no greater than in a block of the same crop growing on adjoining land, where no arsenic had been applied to the soil.

To prevent the possibility of *Anomala* being shipped to other islands, all new cane varieties from the Waipio substation (i.e., in the midst of the infested territory) are cut into sets, subjected to hot water treatment, and boxed in a screened *Anomala*-proof room, before being sent away by steamer.

Beetle Borer.

The beetle borer pest is much less prevalent in the Hawaiian Islands than in the parts of Queensland where it is now firmly established, and although borer is still one of the worst pests of sugar cane in Hawaii, the magnitude of its damage is very slight in comparison with that seen in some North Queensland canefields. In Hawaii, the Tachinid fly parasite exercises a very high degree of control, and is largely responsible for this reduction in borer damage. The system of cropping is an important factor in maintaining the Tachinid fly population in large numbers, crops being usually cut when from 20-24 months old. By this

arrangement it will be apparent that approximately one-half of the cane is harvested each year, and at the end of the crushing season the remaining immature crops are about 12 months old (some older, and some younger, varying of course with the time of planting or harvesting). These young crops have sufficient cane developed to support a borer population as well as a corresponding fly population. In fact, the percentage of parasitism in cane of this age is usually greater than in cane 24 months old. By this means, a large supply of fly parasites is always at hand to migrate to nearby fields as soon as the borer attack commences. In this way a nice balance is maintained, and the borer pest does not gain the ascendency so easily. In North Queensland, on the other hand, practically all of the cane is harvested annually, and the only centres in which the fly is able to maintain itself are the few small sanctuaries left voluntarily by the growers, in unpermitted standover cane, in cane that is too small to harvest, or which has been left as a source of plants for the following year. The adult borer beetle lives for a long period, whilst the fly's life is a comparatively short one. Consequently, the borer is able to survive until such a time as young cane becomes available in which it can lay its eggs and commence breeding again. The fly, on the other hand, soon dies out if it cannot find sufficient borer grubs on which to maintain itself during these unfavourable conditions; and for its increase again it is dependent on a few small colonies maintained in favourable sanctuaries or as outlined above. The lag between borer and parasite is thus often very considerable, and the borer is able to inflict severe damage before the parasite overtakes it. This is probably one of the chief reasons why borer control in Queensland is not all that could be desired. In Hawaii, the time lag between borer and parasite does not exist, and control is ever so much more satisfactory.

Another important factor is that, on the whole, cane is better grown in Hawaii than in Queensland, and therefore is not so attractive to borers; with normal growth (that is, an abundance of plant foods, water, and an absence of pests and diseases) there is very little crowding out of large stalks to cause souring, no top rot, no grub damage, and very little rat damage, all of which are important factors in encouraging borers to commence operations. Moreover, with the normal shedding of the leaf sheaths, parasites are able to operate, whereas where considerable binding of the leaf sheaths takes place, the borers protected by this matted trash are almost invariably not parasitised.* Further, Hawaii is not subject to cyclonic disturbances such as operate almost annually in North Queensland. These cyclones, with their attendant powerful winds and heavy rains, cause some cane to lodge rather badly, or to be otherwise damaged by floods. Trash then covers over the fallen cane, rendering it extremely satisfactory for borer attack, but very unsuitable for the operations of the fly parasite.

* It is thought that with the introduction of the sugar-cane mealy bug parasite, trash binding may in some instances be lessened, for the honey dew secreted by the mealy bugs often helps to make the trash cling to the cane stalk.

In the higher rainfall districts of Hawaii, which are reputedly the worst borer-infested localities, the two chief measures undertaken to minimise borer attack are a system of short cropping and the substitution of varieties possessing a harder rind, which are therefore more resistant to the borer. It has been found that borer control by the Tachinid fly parasite reaches a maximum when the crop is about 14 months old, after which there is a gradual decline in the percentage of parasitism, when the trash blanket becomes too thick and prevents the parasite from gaining access to the borers in the lower portion of the stalks. The plan is then to institute a system of short cropping; that is, the cane is cut at the age of 14-18 months, and by this means the borers are never able to breed up in sufficient numbers to cause really serious damage. By planting canes such as P.O.J. 36 and others which have a harder rind than, say, P.O.J. 2878, it has been possible to reduce borer damage to even smaller proportions. P.O.J. 36 has proved almost immune to borer attack. However, these canes can be grown only in restricted localities, and in recent practice some of the plantation agriculturists find it more profitable to grow the more susceptible variety P.O.J. 2878 than to continue growing P.O.J. 36. Whether borers will become cumulative, and damage still further increase in future years, will be an interesting point to watch.

Rat Damage.

Rat damage is prevalent in areas where much waste land, rock piles, and other rubbish occur, and also where cane has been abandoned on account of quota restrictions. The introduced mongoose can frequently be seen running across the roads, and it is not able to keep the rat down to numbers sufficiently small to prevent serious damage occurring. Its unwelcome activities against many ground-nesting birds are thought to far outweigh any good it might do in killing a few rats. It, therefore, is not considered in a very favourable light in Hawaii.

No further intensive research on rats has been undertaken since the work of Pemberton, and the control measures advocated are much the same as those which he formulated, with the exception that thallium-coated wheat baits have almost completely replaced barium biscuit and strychnine-wheat baits. Squill has been tried, but its killing power does not always appear to be satisfactory, and further research with this compound is contemplated. In addition, it is thought that greater improvement in control could be made by determining more effective baits than wheat, and in this respect oatmeal and the germinal portion of maize seeds offer better possibilities.

Mealy Bugs.

The pink sugar-cane mealy bug is much less common than in Australia. Especially is this so in the drier parts of the Hawaiian Islands, and these are precisely the localities in Queensland where mealy bugs

are often thickly clustered around the nodes of the cane. This scarcity of the mealy bug is due to the operations of a small parasitic wasp, several of which are able to mature in the one mealy bug. A consignment of these wasps has been brought back for colonisation in Queensland canefields.

Army Worms.

Two species of "army worm" are occasionally responsible for considerable damage to young cane, and both of these species are responsible for similar injury in Queensland canefields. *Spodoptera mauritia* appears to give most trouble, and I witnessed damaged portions of fields on the Island of Oahu, where young plant cane was completely stripped of its leaves. Similar damage was seen on Hawaii, and reports from Maui indicated that the same severe damage was occurring there. This damage occurs despite a vast array of parasites at work against these insects, but such outbreaks occur usually when some climatic condition has upset the happy balance existing between host and parasites, enabling the pest to increase suddenly.

Eggs are usually laid on the young cane leaves, and the young caterpillars on hatching out drop by thin threads to the nut-grass below, where they feed for some time, and later migrate to the young cane as they grow bigger. Several plantations follow the practice of having labourers clip these egg masses from the cane leaves and destroy them, but such a procedure is of doubtful value, as it greatly limits the activities of a tiny wasp parasite of the egg, and it only requires that a few egg masses be overlooked to furnish an ample supply of caterpillars which will infest the cane to such an extent as to cause this damage. These caterpillars do not, as a rule,, hide during the day under trash and other debris, like those of the Queensland species, *Cirphis unipuncta*, but feed openly on the cane leaves and in the spindle. Therefore, when artificial control measures are resorted to, a mixture of one part of arsenic to six parts of finely powdered raw rock phosphate is dusted over the entire area, the application being made at the rate of 100-150 lb. per acre. *Cirphis unipuncta* sometimes causes damage in some of the wetter districts, and by virtue of the fact that the usual army worm bait disintegrates rather rapidly under heavy rainfall conditions, the following bait has been evolved, and has proven much more suitable in these wet districts:—

10 lb. bagasse 20 lb. molasses 1 lb. white arsenic ½ lb. casein (Kayso) 2 qt. water.	The arsenic is stirred into the molasses thoroughly before mixing in other ingredients.

Biological Control.

Biological control in Hawaii has given outstanding results. Especially can this be claimed in respect of sugar-cane entomology, and the high degree of control obtained by means of introduced parasites has

become a classical example which is frequently quoted to demonstrate the benefits to be derived from this form of control. The chief reasons for these successes are that Hawaii, in the first place, has a very limited insect fauna, and, in the second place most of the serious pests have been introduced from other countries, and are not native to the Hawaiian Islands. When, therefore, a new pest has gained entry into Hawaii and threatens serious damage, entomologists have gone to the country of origin of the pest, and there sought out and introduced the most effective parasites. These searches have frequently taken them to fever-stricken and inaccessible areas, and much ingenuity was required in transporting the parasites back to Hawaii successfully. These difficulties have been overcome one by one, with the result that most of the formerly important pests (at least so far as sugar-cane is concerned) have been reduced to the status of comparatively unimportant ones. Such a state of affairs has been rendered possible by the fact that these introduced parasites have had a clear field in which to operate, and have not been hindered by the action of hyperparasites. This partly serves to explain why we, in Australia, cannot hope for the same high degree of success as is experienced in Hawaii. In the first place, we are dealing mostly with native pests which formerly fed on the leaves, stalks, and roots of native grasses, but which have now adopted cane as an equally, if not more suitable, host plant. In the second place, the parasite complex of our pests is very large and much involved. If further parasites were introduced, they would in most instances be necessarily so closely related to those already occurring in Australia as to render them liable to severe attack from hyperparasites. They would thus become ineffective as controlling factors of any great magnitude.

The control of the sugar-cane leaf hopper by parasites introduced from Australia, Fiji, and China, the control of the *Anomala* grub by a digger wasp, introduced from the Philippines, and the control of the beetle borer by the New Guinea Tachinid fly are some of the outstanding successes which the entomologists of the H.S.P.A. Experiment Station had to their credit many years ago. But they are not resting on their laurels; rather are they putting forth every effort to make parasite control even more effective. Within recent years the *Scelionid* parasite of grasshopper eggs has been successfully established, also the pink sugar cane mealy bug parasite, whilst during last year several new parasites and predators were imported from Guatemala to assist further in the control of the *Anomala* grub. One of these has already become established, whilst others have been liberated in *Anomala*-infested fields.

These many successes are apt to create the impression that introductions of parasites into Hawaii have been an easy matter. Actually, many parasites have been introduced, bred up to large numbers under laboratory conditions, liberated in the fields, and have afterwards failed to become established. In other cases, such as with the beetle borer, intensive search in many of the East Indian Islands has failed to bring

to light a parasite likely to prove more successful than, or add to the degree of control already being exercised by, the New Guinea Tachinid fly. In some places other parasites were located, but they were either comparatively rare in occurrence, or they were suited more for the wet tropical jungles, where allied borers occur.

Disease Transmission Work.

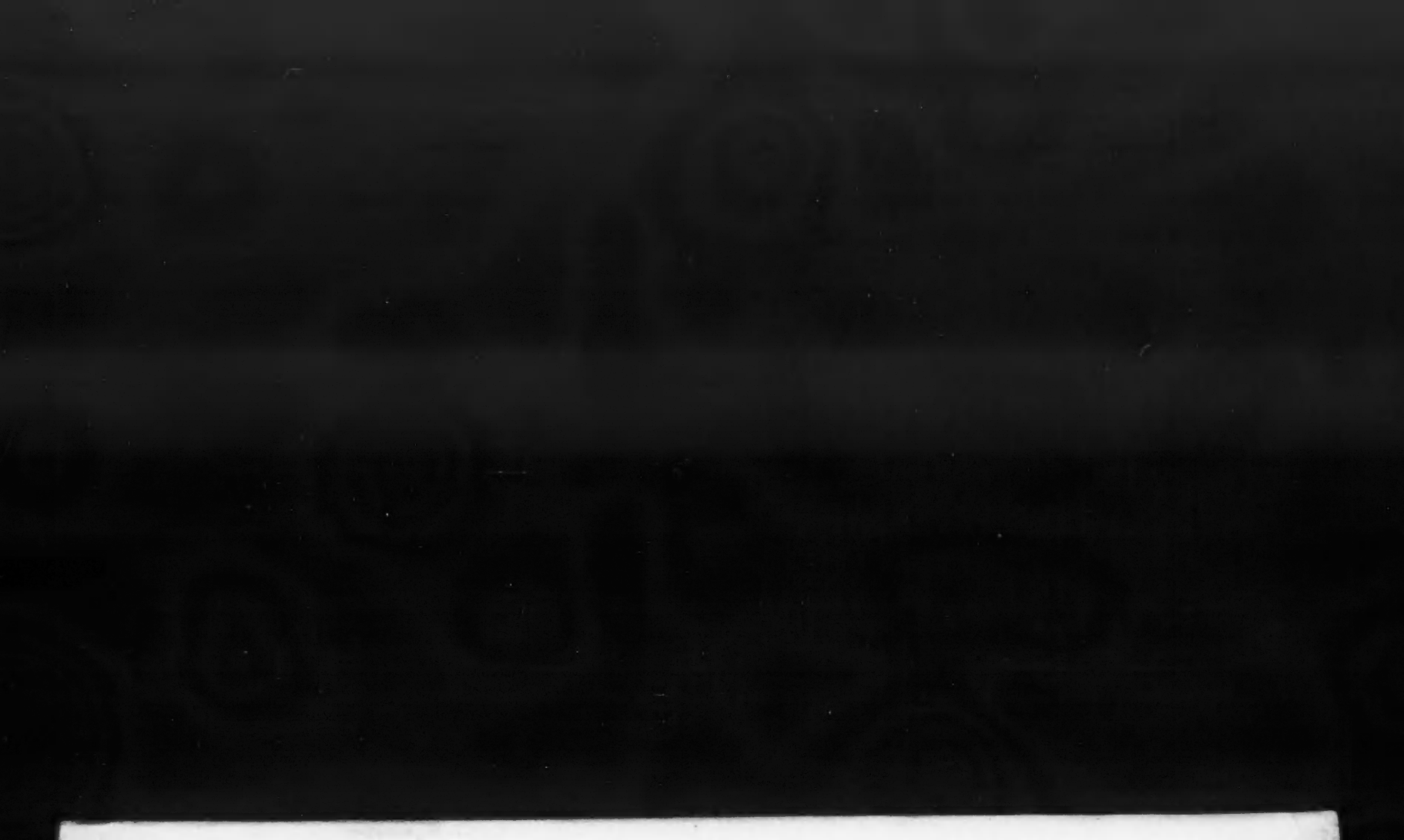
Work was in progress in Hawaii to test the possibility of insect transmission of leaf-scald disease. Cane leaf hopper, cane aphis, and the grasshopper *Oxya chinensis* were being tested, but, although these tests had been in progress for more than a year, no case of transmission had been recorded.

An interesting sight which came under my notice was that of lightning injury to Yellow Caledonia. Where the lightning had struck the ground there was a circular area of about 10 yards in diameter where the cane had been damaged. Some of the cane stalks were dead, and showed considerable charring, whilst others had a prolific development of side shoots. Other stalks which came in contact with a strand of stout fencing wire used to prevent lodging had suffered similar injury for a distance of the entire length of the wire, some 1,200 feet. Certain of these canes displayed symptoms similar to leaf-scald, and later definite leaf-scald symptoms were found in a few stalks. This occurrence has raised the question of the probable masking of symptoms or the latency of the disease in this variety under the normal conditions of growth near Hilo, and the possibility of lightning injury or other serious growth check serving to bring out the typical leaf-scald symptoms.

Chlorotic streak was also seen to occur in some of the wetter localities, such as at Olaa plantation, on Hawaii, and at Kailua, on Oahu. In this latter area, many new seedling canes are being raised and tested annually, and the percentage of infection in these new varieties is very high, indicating a very rapid rate of spread.

No work is being done on this disease so far as attempting to determine possible insect vectors is concerned. The canes undergo a hot water treatment at 52°C. for 20 minutes prior to being sent to other parts of the islands.

Acknowledgment.

I wish to tender my sincere thanks to those in Queensland who made my trip to Hawaii possible, and to those in Hawaii who made my sojourn there so interesting and delightful. To the entomologists of the Hawaiian Sugar Planters' Association Experiment Station I owe a deep debt of gratitude, and particularly so to Mr. C. E. Pemberton, who not only made himself responsible for showing me the detailed activities connected with pest control in Hawaii, but also saw to my personal welfare whilst I was incapacitated for a time through sudden illness.

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